14581/US Hz

CLAIMS (as originally filed and published)

1. A procedure to measure or exert optically-induced forces on at least one particle in the focus of an optical cage with the following steps:
   a) the focus is positioned in a microelectrode arrangement with a three-dimensional electrical field that has a field gradient which forms an electrical capture area and the focus is at a distance from the capture area, and
   b) the amplitude of the electrical field, the light power of the light beam forming the optical cage, and/or the distance of the capture area from the focus are varied to detect at which of said varied field properties the particle is moved from the focus to the capture area or vice versa, or to at least to temporarily move the particle into the capture area.

2. The process according to claim 1 in which a particle is placed in the focus or capture area to measure optically-induced forces, and the optically-induced forces are measured from the amplitude of the electrical field and the distance of the capture area from the focus when the particle moves from the focus to the capture area or vice versa.

3. The process according to claim 2 in which the optically-induced forces are repeatedly measured for all relevant directions in space corresponding to mutual alignment of the positions of the focus to the capture area.

4. The process according to claim 2 or 3 in which the optical cage is calibrated by determining the relationship between the light power to generate the optical cage and the forces induced on a particle in the optical cage.

5. The process according to one of claims 2 - 4 in which the distance between the focus and capture area is at least one-tenth of the particle diameter.

6. The process according to one of the above claims in which the capture area is a capture point that is in the beam field of the optical cage so that the particle moves back and forth between the capture point and focus when the amplitude of the electrode signals or light power is lowered or increased, and the associated value of the amplitude is used to measure the optically-induced forces.

7. The process according to claim 1 in which at least one particle is in the focus and at least one second particle is in the capture area to determine bonding forces between the microscopic particles, whereby the first and second particles contact each other for a predetermined contact period, and then the amplitude of the electrical field, the light power and/or the distance of the capture area from the focus are varied until the first particle can be moved with the focus from the capture area and second particle, whereby the binding forces between the particles are determined from the amplitude of the electrical field and the light power when the particle moves.

8. The process according to one of the above claims in which the electrodes of the microelectrode arrangement are alternatingly supplied with signals phase-shifted 180° and/or with rotation-generating signals with a

predetermined phase division.

9. The process according to one of the above claims in which the capture area is separated by at least one field barrier from the optical cage.

10. The process according to claim 1 in which numerous particles are sequentially injected into the capture area that are positioned in set positions with the optical cage in the capture area relative to possibly existing particles in the capture area.

11. The process according to one of claims 1 - 6 in which the light beam of the optical cage is adjusted and/or the capture quality, symmetry or other calibration properties of the optical cage are measured.

12. The process according to one of claims 1 - 6 in which the particle is characterised based on the measured optically-induced forces.

13. The process according to one of the above claims in which the particle movement is optically and/or electrically detected.

14. The process according to one of the above claims in which the particles are synthetic or natural particles with a size below 200 µm.

15. The process according to one of the above claims in which the particles are biological cells or their components.

16. The process according to one of the above claims in which the transitional movement of the particle from the capture area to the focus or vice versa is used to adjust the optical cage.

17. A device to measure or exert optically-induced forces on at least one particle in the focus of an optical cage that comprises:
   - a fluid microsystem with a microelectrode arrangement that is set up to form a three-dimensional electrical field with an electrical capture area,
   - an illuminating device that is set up to form an optical cage in the microelectrode arrangement of the microsystem, and
   - an monitoring and/or detection device to measure the movement of particles in the microelectrode arrangement.

18. The device according to claim 17 in which the microelectrode arrangement comprises flat electrodes that are in groups on two spaced substrates of which at least one is transparent.

19. The device according to claim 18 in which the thickness of the transparent substrate is less than 500 µm.

20. The device according to claim 18 in which the electrodes are attached to facing surfaces of the substrates, and the substrates are separated from each other by a spacer that forms a suspension area into which the focus of the optical cage can be coupled by the illumination device through one of the two substrates.

21. The device according to claim 20 in which the suspension area is part of a channel structure through which the particles are introduced by means of a flow of solution into the field of the microelectrode arrangement.

22. The device according to one of claims 17 - 21 in which

the microelectrode arrangement comprises numerous electrodes that are set up to generate a multipole field with an electrical field distribution symmetrical in the x, y and/or z direction.

23. The device according to one of claims 17 - 22 in which the electrodes are coated with an insulating, dielectric layer or consist of metals that are essentially inert to the suspension liquid in the microsystem.

24. The device according to claim 23 in which the electrodes consist of platinum, titanium, tantalum or gold.

25. The device according to one of claims 17 - 24 in which electrodes are constructed in three-dimensional shapes using methods from semiconductor technology, or are constructed using hybrid techniques.

26. The use of a procedure or a device according to one of the prior claims to calibrate a laser tweezer.

27. The use of a procedure or a device according to one of the prior claims to selectively stimulate biological cells.

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add B'